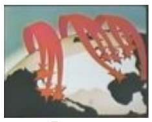
# RDS-27 (product 27).



pn64
March 20, 2013

Tritium-free modification of RDS-6s of medium power.

*"At the same time as the development of the RDS-37, KB-11 was working on "safety charges": RDS-7 and RDS-27 .*
*In the dissertation of M.P. Shumaev it is noted that RDS-27 was carried out under the supervision of A.D. Sakharov, Yu.A. Romanov (with the participation of M.P. Shumaev) and under the general supervision of Yu.B. Khariton. RDS-27 is an atomic bomb with a thermonuclear force, 90% due to fission. This is RDS-6s, but without tritium, which significantly improved the operational characteristics. Double initiation was used for reliability . RDS-27 was put into service (RDS-27 was tested on 6.11.55, its yield of 250 kt turned out to be close to the calculated one ). When substantiating the characteristics of RDS-27, the method for calculating the energy release developed by Yu.A. Romanov, who improved the efficiency theory of Landau, Khalatnikov."*
http://www.iss-atom.ru/pub/pub-82.htm

It seems to me that some clarifications are necessary. At the same time, we will read the documents (from the 2nd book of the 3rd volume).

"At the same time as the development of the RDS-37, KB-11 was working on **"safety charges"** : RDS-7 and RDS-27."
I don't quite agree. Rather, we should talk about a bird in the hand (RDS-27) and a crane in the sky (RDS-37).
Look here:

**From the minutes of the extended meeting of the Scientific and Technical Council of KB-11 on December 24-25, 1954:**
*"Summary of speeches.*
*Comrade Malyshev pointed out the extreme necessity of completing all work on a medium-power product in the dimensions of the RDS-6s in 1955.*
*The most appropriate variant of such a product should be considered a design made of U-235. The use of the RDS-6s product without tritium does not provide the necessary power of up to 250 kilotons and does not allow a rapid increase in the stock of bombs due to the shortage of lithium-6 compared to uranium-235. The power of the RDS-6s product without tritium can be increased by using INI (T. Sakharov)."*
p. 291

Malyshev (Minister of Medium Machine Building) needs medium-sized tits of certain dimensions in commercial quantities. Even uranium ones, or any other kind.
Why? Most likely because a decent amount of media is developed for this size.
Why "medium" and not "large"? - see **PS.** We'll count the money while we're at it.

In January 1955, the development of such a product was included in the work plan of KB-11. The bomb received a name. **[1]**

February 1955. Carriers of the future warhead based on the RDS-27 - R-7 and the Buran cruise missile. Tests must be conducted in November-December (dropped from a Tu-16 or M). **[2]**

The combat product for the K-20 will have a NZ, for the R-7 and Buran - with a NZ and INI. **[3]**

July 1955 At first they talked about TE 150-250 kt. Now - 300 - 400 kt. **[4]**

September. "For reliability of operation, double initiation was used." - yes, that was in the plans. **[5]**

In terms of efficiency, the RDS-27 is much inferior to the RDS-37. But the RDS-27 still needs to be launched into serial production. **[6]**

This is not a "hydrogen bomb" but a "thermonuclear-boosted atomic bomb." **[7]**

RDS-27 will be dropped from the Tu-16. Expected TE - 275 - 400 kt. **[8]**

End of October. Tests will have to be postponed. **[9]**

"RDS-27 was tested on 6.11.55, its yield of 250 kt was close to the calculated one." The test report says differently. **[10]**

*"If INI was used in these bombs, one could expect a yield of about 300 thousand tons."* So, INI was not used after all? **[11]**

Result:
*"b) organize in 1956 serial production of RDS-27 products; "*
**Resolution of the USSR Council of Ministers No. 46-31ss on the results of testing the RDS-27 and RDS-37 products, serial production of the RDS-27 product, development and manufacture of products based on the principle of atomic compression, January 5, 1956.**
With. 435

---

**[1]** *"The 1955 plan included the development of the RDS-27 product in the RDS-6s dimensions with a capacity of 150-250 kt."*
**Covering note by V.A. Malyshev to the plan of experimental design work of KB-11 on the development of new types of atomic and hydrogen weapons. January 20, 1955.**
p. 303

**[2]** *"4. Development of the RDS-27 product in the dimensions of the RDS-6 product with a full TNT equivalent of 200-250 thousand tons and a main charge of uranium-235 (...)% concentration weighing (...) kg.*
*The RDS-27 product, along with the RDS-6s product, can be used in the R-7 super-long-range missile and the Buran cruise missile.*
*The RDS-27 product is scheduled to be tested at the No. 2 testing ground of the USSR Ministry of Defense in November-December 1955 by dropping it from a Tu-16 or M aircraft."*
**Letter from V.A. Malyshev, G.K. Zhukov, B.L. Vannikov and others to the Presidium of the Central Committee of the CPSU with the presentation of a draft resolution of the USSR Council of Ministers on the work plan of KB-11 and the testing program for RDS products in 1955.**
**February 17, 1955**
p. 313

*"The presented plan for scientific research and development work by KB-11 for 1955 provides for the development and production of experimental atomic bombs of the RDS-6SD and RDS-27 types in a caliber of 1500 mm.*
*The specified caliber (1500 mm) was chosen based on the need to place atomic and hydrogen charges in long-range missiles of the R-7 and Buran types, for which an increase in the caliber of atomic charges is associated with a sharp decrease in their flight range. "*
**Letter from A.P. Zavenyagin, B.L. Vannikov, Yu.B. Khariton, E.P. Slavsky, I.V. Kurchatov and P.M. Zernov to the Presidium of the CPSU Central Committee presenting a draft resolution of the USSR Council of Ministers on supplementing the KB-11 work plan for 1955.**
**March 14, 1955**
p. 336

**[3]** *"III. Product RDS-27*
*1. To approve the design version of the RDS-27 product with a uranium-235 core weighing (...) kg with a full TNT equivalent, according to calculated data, presented by KB-11, (...) thousand tons with a NZ and (...) thousand tons with a TNT equivalent.*
*2. Recommend placing (...) the charge and automation of the RDS-27 product in the K-20 carrier with a NZ, and in the R-7 and Buran carriers - with a NZ and INI.*
*3. (...)*
*4. Accept the proposal of KB-11 to equip serial RDS-27 products with the INI and NZ device."*
**Decision of the meeting of the Minister of Medium Machine Building on KB-11 issues, May 31, 1955.**
p. 365

**[4]** *"As a result of the work carried out by KB-11, a design was proposed for the RDS-27 product (with the dimensions of the RDS-6s) with a main charge of uranium-235 weighing (...) kg and lithium-6 deuteride weighing (...) kg, which, according to calculations, has a full TNT equivalent of 300-400 thousand tons ,*

the archives here.

> But I know that Terletsky's textbook "Statistical Physics" is quite good.

I…

**lyupus_est**
Dec 19, 2023, 11:57 AM

Questions for Boru.

Well, I don't believe much in anything except formulas. But I know that Terletsky's textbook "Statistical Physics" is pretty good. Perhaps the intelligence officers decided to try all the options for obtaining information, and that's it...

**pn64**
Dec 19, 2023, 11:53 AM

Questions for Boru.

> I quoted from Terletsky's memoirs. They are online. I'm selling it for what I bought it for. Terletsky himself is perplexed as to why this was necessary and offers this explanation.

I get it.

> I'm not sure,…

*which corresponds to a burnup of (...)% of uranium-235. Testing of the RDS-27 product at test site No. 2 is planned for September of this year."*

**Letter from A.P. Zavenyagin, E.P. Slavsky, and I.V. Kurchatov to the Presidium of the Central Committee of the CPSU with the presentation of the draft resolution of the USSR Council of Ministers "On testing RDS products at Training Ground No. 2 of the USSR Ministry of Defense"**
**July 2, 1955**
p. 375

**[5]** *"The expert commission, appointed by order of the chief designer No. 0186 of September 15 of this year, consisting of V.M. Nekrutkin (chairman), B.N. Ledenev (deputy chairman), L.V. Altshuler, V.N. Rodigin, V.K. Orlov, L.M. Timonin, N.A. Popov (members), examined the drawing and technical documentation, reports on experimental studies of the charge and the central part of the product, as well as theoretical calculations.*
*Below are the results of the review and conclusions of the commission.*
*I. Schematic diagram of the RDS-27 charge*
*The expert commission reviewed the materials submitted by sectors No. 1 and 2 to justify the choice of the design scheme of the RDS-27 product (see inventory No. 9/614-op, 9/568-op, 9/596-op, 9/444-op; case 9/4-OP - report on assignment No. 248), and agreed that the design scheme of the RDS-27 product is close to optimal in this size among products operating on the principle of a multilayer charge.*
*The design scheme of the RDS-27 product is close to the design scheme of the tested RDS-6s product (see figure).*
*(...)*
*The Commission notes an important advantage of the RDS-27 product over the RDS-6s product, namely, the absence of product 213 (tritium - pn64) in the charge, which, in addition to being cost-effective, greatly simplifies issues of manufacturing technology and operation of the product related to the radioactivity of product 213.*
*(...)*
*II. Design features of the RDS-27 product charge*
*(...)*
*III. Mechanical tests of the RDS-27 product charge*
*(...)*
*IV. Symmetry of the detonation wave in the charge*
*(...)*
*The totality of experimental data allows us to conclude that the symmetry of the converging shock wave in product 27 is satisfactory.*
*V. Selection of a nuclear reaction initiation system*
*(...)*
*VI. Determining the operating time of the product*
*One of the important goals of testing the RDS-27 product is to check the operation of the TI in this design.*
*(...)*
*VII. On possible reductions in the efficiency of the RDS-27 product*
*(...)*
*VIII. Conclusions*
*As a result of reviewing all the materials presented on the RDS-27 product, the commission came to the following conclusions:*
*1. Consider the scientific and technical development of the RDS-27 prototype to be sufficient, and therefore it is advisable to allow it to be tested at test site No. 2.*
*2. The commission considers the proposed version of testing the RDS-27 product with two initiators (TI and INI) to be appropriate.*
*(...)*
*5. The Commission believes that for the final development of the RDS-27 product as a missile warhead, it is necessary to complete mechanical testing of the product."*

**Conclusion of the expert commission on the RDS-27 product, September 22, 1955.**
p. 392-393

**[6]** *"Using the experience of working with the 1953 hydrogen bomb and the RDS-6D design, KB-11 developed the RDS-27 with a charge of (...) kg of uranium-235 and (...) kg of lithium-6 deuteride with a calculated total TNT equivalent of 275–400 thousand tons.*
*This product will be similar in power to the hydrogen bomb tested in 1953, but it will not contain tritium. The absence of tritium in the RDS-6sD and RDS-27 products represents a great relief in the manufacture of the products and their storage, in safety for workers and other personnel who will deal with them.*
*The RDS-27 product and the product with atomic compression planned for development have almost the same charge of uranium-235, but the efficiency of the RDS-27 product is expected to be 3-6 times lower than the efficiency of the product with atomic compression.*
*It would seem that in the case of a successful test of a product with atomic compression, there is no point in testing and manufacturing the RDS-27 product. However, we are forced to do this, since in practice, a product with atomic compression in a favorable case can be put into serial production no earlier than the end of 1956.*
*The Ministry of Medium Machine Building considers it necessary to establish the following testing procedure: first test the RDS-27 product, then the RDS-37 product, and then the RDS-6sD product if the tests of the RDS-37 product are unsatisfactory."*

**Letter from A.P. Zavenyagin, V.D. Sokolovsky, I.V. Kurchatov and Yu.B. Khariton to the Presidium of the Central Committee of the CPSU with the presentation of the draft resolution of the USSR Council of Ministers "On the testing of RDS products"**

**October 5, 1955**
p. 396

**[7] Report by Yu. B. Khariton and A. D. Sakharov "Atomic bomb with thermonuclear enhancement RDS-27", October 7, 1955.**
*"Product 27 is a multilayer charge with (...) in the dimensions of RDS-6S (Ref = (...) mm).*
*The main charge consists of (...) kg of uranium-235 (...)% concentration. It can be initiated by a conventional neutron fuse (NF) and an external pulsed neutron source (EPNS).*
*In this size, the product is optimal in terms of efficiency among products operating on the principle of multilayer charging.*
*(...)*
*The product consists of alternating spherical concentric light and heavy layers. The composition, weight and radii of the layers in the assembly are given in Table 1.*
*(...)*
*The energy release of the system was calculated in the OPM in the bureau of A.N. Tikhonov for two moments in time: (...).*
*The energy release is equal to 21.7 kg (375 thousand tons) and 24.4 kg (420 thousand tons), respectively.*
*(...)*
*Based on the experimental power of the RDS-6S in the 1953 experiment, which was 20% lower than the calculated one, the expected power of product 27 will also be 20% lower than the calculated one."*

**[8]** *"The Council of Ministers of the USSR DECIDES:*
*1. Accept the proposal of the Ministry of Medium Machine Building and the Ministry of Defense of the USSR to conduct tests in October-November 1955 of new designs of powerful RDS products:*
*a) RDS-27 products (...) with an expected total TNT equivalent of 275–400 thousand tons;*
*[...]*
*2. To approve the following test procedure:*
*a) The RDS-27 product is tested by dropping it from a Tu-16 aircraft from a height of 10-12 thousand meters. The product is detonated in the air at a height of about 1000 meters."*
**Resolution of the USSR Council of Ministers No. 1808-967ss "On testing RDS products", October 8, 1955.**
p. 403-404

**[9]** *"Moscow, Presidium of the CPSU Central Committee*
*The first test (RDS-27 - pn64) has to be postponed until the beginning of November.*
*During the first test, the aircraft will receive up to 10 calories of heat per square centimeter from the absorption of light. Taking into account the wind blowing, this will lead to the skin heating up to 70 °C, which is quite acceptable. However, it is necessary to carefully close all the cracks through which light can penetrate into the aircraft and create temperatures at which some materials, mainly textiles, located inside the aircraft, not in the wind, can catch fire.*
*The work of protecting the aircraft from light was originally intended to be carried out here.*
*Comrade Tupolev considers it necessary to do this in factory conditions in Moscow.*
*We agreed with this and sent planes to Moscow today.*
*For the second test (RDS-37 - pn64), when the heating of the aircraft skin is expected to be significantly higher, in addition to work to prevent light from entering the aircraft, it is necessary to cover the aircraft with a special paint that provides better light reflection.*
*In addition, we discuss the issue of using a parachute and the advisability of using clouds to reduce the intensity of light.*
*According to Comrade Tupolev, work to protect the aircraft from light will require up to two weeks.*
*We believe that the first aircraft, which requires less work, will be completed in a week to ten days.*
*On October 21, a dress rehearsal was held. The test article was dropped from a Tu-16 aircraft from a height of 12 thousand meters and exploded at a specified height of 1000 meters with a deviation from the target of 216 meters, with an acceptable deviation of 500 meters.*
*The Experimental Field's automation was launched by a radio signal from an airplane and worked normally.*
*At the same time, a public notification service was carried out to ensure safety during the experiment.*
*The inspection showed the service's preparedness."*
**Transmittal note by B.L. Vannikov to the Presidium of the Central Committee of the CPSU to the report by A.P. Zavenyagin, M.I. Nedelin, I.V. Kurchatov and P.M. Zernov on issues of testing RDS-27 and RDS-37 products (Appendix), October 25, 1955,**
p. 411

**[10]** *"To Comrade Khrushchev N.S.*
*To comrade Bulganin N.A.*
*On November 6, 1955, at 10:40 a.m. local time, the RDS-27 product was tested at the testing ground No. 2 of the USSR Ministry of Defense. A Tu-16 aircraft was used for the test. The product was dropped from a height of 12 thousand meters and detonated at a specified height of 1000 meters.*
*Over the past 3 days, photographs of the explosion's fireball were developed, and instrumental records of the shock wave, gamma and neutron radiation were analyzed.*
*Based on these data, the full TNT equivalent of the RDS-27 product was determined to be 220-250 thousand tons. For a product of the specified power, the most advantageous detonation height, from the point of view of the destruction of structures and equipment, is approximately 650 meters. In order to avoid radioactive contamination of the surrounding area, the detonation height was increased to 1000 meters. This ensured complete safety for the surrounding population. However, the impact of the product on*

*structures and military equipment placed on the Experimental Field of the testing ground was weakened due to this. It was equivalent to the explosion of 150 to 250 thousand tons of TNT.*
*The testing of the RDS-27 device was accompanied by unusual phenomena at long distances. In Ust-Kamenogorsk, at a distance of about 320 kilometers, an explosion was clearly heard, in a number of buildings glass was broken or window frames were torn off. In the settlement of Gornyak, at a distance of about 225 kilometers, an explosion was heard, in the boiler room partitions were destroyed and glass was broken. There were no casualties. The explosion was heard in Barnaul (510 kilometers), Rubtsovsk (250 kilometers), Aleysk (400 kilometers), Ayaguz (320 kilometers).*
*While it was snowing in the area of the test site and the explosion was poorly observed, it was clearly visible from Semipalatinsk (170 kilometers). The TNT equivalent of the explosion was lower than the KB-11 calculations (275-400 thousand tons). In this product it can be increased to 300 thousand tons due to (...). The RDS-27 had a charge of (...) kilograms of uranium-235 and (...) kilograms of lithium-6 deuteride. It is 40% more expensive than the RDS-3, but its power is 4 times higher. Thus, as a result of the November 6 test, work was completed on creating a new powerful, economical product for the Soviet Army. According to its data (structural strength, weight), the RDS-27 can be used both as an aerial bomb and as a special charge for the R-7 transcontinental ballistic missile.*

*Zavenyagin*
*Nedelin*
*Zernov*
*Kurchatov*
*Khariton*
*Muzrukov*
*Sakharov*
*November 9, 1955*

Note (3) - So in the document. "
**Transmittal note from B.L. Vannikov to N.S. Khrushchev and N.A. Bulganin with the presentation of a report on the results of testing the RDS-27 product. Appendix. November 9, 1955,**
p. 416-417

**[11]** ***" Memo by A.P. Zavenyagin, G.K. Zhukov, I.V. Kurchatov and P.M. Zernov to the Presidium of the CPSU Central Committee with the presentation of a draft resolution of the Council of Ministers of the USSR.***
*December 28, 1955*
*Top secret*
*(Special folder)*
*To the Presidium of the Central Committee of the CPSU*
*According to the decree of the Central Committee of the CPSU of October 8, 1955, the Ministry of Medium Machine Building was obliged to conduct testing:*
*— the RDS-27 hydrogen bomb with a charge of (...) kg of uranium-235 and (...) kg of lithium-6 deuteride;*
*— the RDS-37 hydrogen bomb, based on the principle of atomic compression, with a capacity of 1.0–2.0 million tons and*
*— a RDS-6sD hydrogen bomb with half the charge (...) kg of uranium-235 and half the power of up to 1.0 million tons, in the event of unfavorable results of the RDS-37 tests.*
*On November 6 of this year, tests of the RDS-27 product were conducted. The yield obtained was 220-250 thousand tons of TNT equivalent. If INI is used in these bombs, a yield of about 300 thousand tons can be expected. "*
p. 429

---
**P.S.**
It was said above that the RDS-27 carrier was also supposed to be the R-7.
It would seem, why would a relatively low-power warhead be placed on an intercontinental missile? With a CEP measured in kilometers?
And here's why:

***" On the selection of products for strategic use.***
*April 21, 1955*
*Top secret*
*(Special folder)*
*Ex. No. 1*
*To comrade Zavenyagin A.P.*
*At present, it is necessary to define the main type of product with a conventional crimp intended for strategic use.*
*Calculations carried out in 1954-55 showed that in the RDS-6 dimensions, with the expenditure of (...) kg of U-235, the following products could be manufactured:*
*I. One SD-type product with a capacity of 1.8 million tons , with a destruction zone diameter of 12.2 km (destruction zone area of 117 km2).*
*II. Two SD-type devices with a capacity of 1 million tons each, with a destruction zone diameter of 10 km. (Total area of the zone 78 km2 x 2 = 156 km2.)*
*III. Five RDS-27 units with a capacity of 0.35 million tons each , with a destruction zone diameter of 7 km. (Total area 38 km2 x 5 = 190 km2.)*

*If we take into account the cost of the carrier (R-7 rocket) and lithium deuteride six, then the costs of one SD product with a capacity of 1.8 million tons are equal to the costs of 4 RDS-27 products. Accordingly, the ratio of the affected area will not be 190:117, but 152:117.*
*In our opinion, RDS-27 products are the best among strategic products with conventional compression. These products provide the largest area of destruction, provide the greatest flexibility of use and the ability to destroy the maximum number of targets, and also increase the reliability of target destruction with the possibility of shooting down carriers or with significant dispersion during firing.*
*The most important practical conclusion from our point of view is the need to expand the production of ultra-long-range missiles and carrier aircraft in accordance with the production of U-235 at the rate of (...) kg per product.*
*A.Alexandrov*
*Y. Khariton*
*A. Sakharov*
*Ya. Zeldovich*
*"*
p. 358-359

About money.
One can estimate how the cost of the designed R-7 and nuclear warheads related in 1955.

Let's introduce the following notations:
(SD) - cost of RDS-6sd (1.8 Mt),
(27) - the cost of RDS-27 and
(P-7) - cost of P-7.

As follows from the contents of the note, the amount of uranium-235 in the RDS-6sd (1.8 Mt) is 5 times greater than in the RDS-27. Let us assume that the ratio of the costs of the bombs is in the same proportion, that is: (SD) = 5*(27).
Since there were no missiles with separating warheads at that time, we get the second equation ("If we take into account the cost of the carrier (R-7 missile) and lithium deuteride six, then the costs of one SD product with a capacity of 1.8 million tons are equal to the costs of 4 RDS-27 products.")
(P-7)+(SD) = 4*(P-7) + 4*(27).
From these two equations we get: (27) = 3*(R-7). Am I wrong anywhere? That is, the RDS-27 bomb in 1955 cost as much as 3 R-7 missiles?
It is clear that the "seven" was not in hardware at that time. But the result is unusual.

**PPS.**
*"The RDS-27 product had a charge of (...) kilograms of uranium-235 and (...) kilograms of lithium-6 deuteride. It is 40% more expensive than the RDS-3 product, but its power is 4 times higher."* **[10]**

Therefore, the RDS-27 was supposed to replace the RDS-3.
Initially, it was planned to produce a new bomb in a quantity of at least 750 pieces:

*"Instructions from A.P. Zavenyagin to the director of the State Union Design Institute No. 11 A.I. Gutov on the revision of the design assignment for Plant No. 418.*

*June 27, 1955*
*Top secret*
*(Special folder)*
*(Personally)*

*To comrade Gutov A.I.*
*Revise the design assignment for Plant No. 418 to a capacity of 750 units of RDS-27 type products instead of RDS-3 type products, as provided for in the previously issued planned assignment.*
*Please advise the shortest possible time for revision.*
*Continue issuing design documentation for the approved title of 1955 regardless of the revision of the design assignment.*
*The plan for cooperation in the production of products will be issued by the Main Directorate of Instrument Engineering by 30.VI. 1955."*
p. 368

Tags: USSR , Nuclear weapons

( 16 comments - Leave a comment )

**pfc_joker**
2013-03-21 08:57 (UTC)

Traditionally, many thanks!

I'm a little confused, what was in more short supply - lithium deuteride or uranium-235? On the one hand, it seems to be written in plain text that there was a shortage of lithium deuteride:

*"The use of the RDS-6s product without tritium does not provide the necessary power of up to 250 kilotons and does not allow a rapid increase in the stock of bombs* ***due to the shortage of lithium-6 compared to uranium-235*** *."*

*"To manufacture a bomb with a capacity of 20-30 million tons, (...) lithium-6 deuteride up to (...) kg will be required. To do this, it will be necessary to take all the lithium-6 from the production of the first three quarters of 1956 and from previously manufactured hydrogen bombs, so that it can be compensated for in the next 2-3 quarters."*

But on the other hand, the consumption of lithium deuteride is often not mentioned at all, and only the consumption of uranium-235 is discussed:

*"According to the five-year plan, it was planned to manufacture 240 hydrogen bombs of the previous design for the period 1956-1960, with a total capacity of 370 million tons of TNT, and to use for this purpose (...) kg of uranium-235. Now it is possible to manufacture several times more hydrogen bombs and with a total capacity much greater than previously planned, with the same consumption of atomic explosives."*

*"The most important practical conclusion from our point of view is the need to expand* ***the production of super-long-range missiles and carrier aircraft in accordance with the production of U-235*** *at the rate of (...) kg per product."*

*"The RDS-27 product and the product with atomic compression planned for development have almost the same charge of uranium-235, however, the efficiency of the RDS-27 product is expected to be 3-6 times lower than the efficiency of the product with atomic compression."*

How should this be understood?

And also: *"The energy release of the system was calculated in the OPM in the bureau of A.N. Tikhonov for two moments in time: (...).*
*The energy release is equal to 21.7 kg (375 thousand tons) and 24.4 kg (420 thousand tons), respectively."*

Does this mean that the energy release corresponds to the entry into a chain reaction of the specified masses of U-235? That is, the contribution to the energy release of the thermonuclear reaction and its efficiency is ignored, or have I misunderstood something?

Answer Discussion thread ♥ Like Complain

**pfc_joker**
2013-03-21 09:12 (UTC)

As for the comparative cost of the RDS-27 and the R-7 ICBM - it seems that everything was calculated correctly, but the result is very unexpected, especially considering that the RDS-27 was not uniquely expensive ( *"40% more expensive than the RDS-3"* ).

I'll try to look in the collection "Task of Special National Importance", it seems that there was some data on the cost of missiles.

*Edited at 2013-03-21 09:13 (UTC)*

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-21 12:10 (UTC)

>As for the comparative cost of the RDS-27 and the R-7 ICBM — it seems like everything was calculated correctly, but the result is too unexpected, especially considering that the RDS-27 was not uniquely expensive ("40% more expensive than the RDS-3").

>I'll try to look in the collection "A Task of Special National Importance", it seems there was some

data on the cost of missiles.

It would be very interesting. Only - this is 1955. All data on the R-7 is preliminary.

Simonov has this (not about the R-7, unfortunately):
"So, on the scale of 1962 prices, the R-9 "product" without launch equipment cost 1,374.3 thousand rubles, and the R-16 "product" - 1,418 thousand rubles."
http://militera.lib.ru/research/simonov_ns/05.html

In 1955 prices, R-16 ~ 14 million rubles. That is, RDS-27 (roughly 3 R-16) ~ 42 million rubles. This is the price of only 20 kg of 90% U-235 in 1953 (2117 thousand rubles per 1 kg - the planned average annual price for 1953):
http://bookre.org/reader?file=452594&pg=513

Answer Level up Discussion thread Like Complain

**pfc_joker**
2013-03-22 09:25 (UTC)

*I'll try to look in the collection "A Task of Special National Importance"*

I looked briefly, unfortunately, I didn't find any estimates of the cost of a serial R-7. There is this:

1) *The cost of a modern long-range bomber <…> will be calculated at approximately 50-60 million rubles.*
(Memorandum of V.A. Malyshev and M.V. Khrunichev to G.M. Malenkov, October 19, 1953; p. 335)

2) *A serially produced R-5 type product will cost about 1 million rubles, and therefore its use for transporting 1 ton of conventional explosive will be unjustified.*
(Report by V.A. Malyshev and others to the Presidium of the Central Committee of the CPSU on the creation of a long-range missile with an atomic charge, November 25, 1953; p. 340)

3) The closest to the essence of the question that I found: both the R-7 missile and the year 1955, but, unfortunately, we are not talking about serial production.

*The estimated cost of the first prototypes of the R-7 missile (without equipment) will be no less than 60 million rubles, the Burya missile - no less than 90 million rubles.*
(Memorandum by M.V. Khrunichev and V.M. Ryabikov to N.S. Khrushchev and N.A. Bulganin on the draft control figures for the five-year plan for the development of jet technology for 1956-1960, June 20, 1955; p. 474)

In principle, it is natural to expect that the price of a production rocket was planned to be several times less.

Ibid.: *The total cost of the draft control figures for the five-year plan will amount to 96.2 billion rubles, including 48.4 billion rubles for the fulfillment of the plan for the production of missile and jet weapons.* (p. 475)

Well, and 4) at the end there is an interesting table comparing the cost of aviation and missile units and formations as of 1959. A couple of points from there:

*Cost of equipment:*
*R-12 missile regiment - 71 million 257 thousand rubles (the regiment took 8 missiles of 1 million 800 thousand each without a special charge).*
*TBAP on Tu-16 - 126 million 926 thousand rubles.*
*TBAD of 2 regiments on Tu-95 - 925 million 584 thousand rubles.*
(Report of K.A. Vershinin to the Central Committee of the CPSU on the estimated cost of aviation and missile formations and units of the Air Force, December 23, 1959; pp. 908-909)

As can be seen, for a missile regiment the cost of one set of missile ammunition (excluding the cost of nuclear charges) is approximately four times less than the cost of launch equipment, vehicles, etc. For aviation units, the cost of aircraft is not indicated separately, but assuming that aircraft accounted for 2/3 of the total cost and that there were 20 bombers in a bomber regiment, we get about 4 million rubles for a Tu-16 and about 20 million rubles for a Tu-95 - still noticeably less than the estimate of Malyshev and Khrunichev, on the basis of which they convinced Malenkov to replace bombers with missiles.

Well, for comparison, I estimated the cost of uranium and plutonium in bombs whose charge weights we know, in 1953 prices:
RDS-5 (0.8 kg Pu-239) - 3.4 million rubles,
RDS-5 (2 kg Pu-239) - 8.4 million rubles,

RDS-1 (and RDS-2, as far as I understand?) - about 27 million rubles;
RDS-4 (4.2 kg Pu-239 + 6.8 kg 90% U-235) - about 32 million rubles;
RDS-3, as the most powerful of the atomic bombs, is apparently a little more expensive than RDS-4? For example, 40 million, then RDS-27 in these prices turns out to be more expensive than 50 million, but by 1955 uranium and plutonium should have become somewhat cheaper. There is no later data on their cost in the "Atomic Project"?

It seems that it really turns out that at least as of the mid-50s, the most expensive carriers were no more expensive than relatively cheap charges, and only the cheapest charges were at least comparable in cost to mass carriers. Perhaps that was the case, but it is still a bit unexpected.

P.S. It would be necessary to somehow make a selection of documents from the "Tasks of Special National Importance" that somehow mention nuclear charges for missiles. Unfortunately, there are not too many of them, but there is still something there.

Answer Level up Discussion thread Like Complain

## RDS-4. Clarifications.

**pn64**

2013-03-23 06:47 (UTC)

The RDS-4 bomb tested in 1953 did have a plutonium charge (like the RDS-2).

At first, it was assumed that the main charge (MC) of the RDS-4 would be similar to the RDS-3 charge. And now we know what the RDS-3 MC was (taking into account the document from atomhistory).

*"In 1952-1953, Design Bureau No. 11 of the Ministry of Medium Machine Building developed designs for new types of atomic bombs: [...]*
*b) the RDS-4 bomb with a composite charge of (...) kg of plutonium and (...) kg of uranium-235 (...)% concentration with a total weight of 1.2 tons, a diameter of 820 mm and an expected full TNT equivalent of 25 thousand tons;*
*[...]*
*The planned tests of the above-mentioned products have the following objectives: [...]*
*b) the RDS-4 product has the same atomic charge as the RDS-3 product tested in 1951 , with the difference that instead of (...) kg of uranium-235 (...)% concentration, the same amount of uranium-235 (...)% concentration will be used.*
*The main difference between the RDS-4 product and the RDS-3 product is in weight and dimensions. Instead of 3.2 tons of weight and a diameter of 1250 mm for the RDS-3 product, the RDS-4 product has a weight of 1.2 tons and a diameter of 820 mm. This allows testing the RDS-4 product from an Il-28 aircraft, which has a higher speed than the Tu-4.*
*The task of testing the RDS-4 product is also to determine the full TNT equivalent, which, according to KB-11 calculations, is expected to be about 25 thousand tons.*
*The testing of the RDS-4 product is planned to be the second in a row."*
**Letter from V.A. Malyshev and others to G.M. Malenkov ..., July 4, 1953.**
"The USSR Atomic Project", v.2, book 7, pp. 546-547

*. "By the summer of 1953, the development of the design of the hydrogen bomb model (RDS-6s product) was completed, the design of the RDS-4 bomb was reworked, in which uranium-235 (...)% concentration was replaced by the same amount of uranium-235 (...)% concentration, which made it possible to increase its expected TNT equivalent from 17 to 25 thousand tons... "*
**Draft report of the MSM to G.M. Malenkov on the status of work and tasks in the field of use of atomic energy, July 9, 1953.**
"The USSR Atomic Project", v.2, book 7, p. 550.

*"3. The experimental RDS-4 atomic bomb was manufactured by KB-11 in 3 copies, the main charge of plutonium and uranium-235 was manufactured by Combine No. 817 in 2 copies."*
**Act and decision on the readiness of the RDS-4 product for testing, July 17, 1953.**
"Atomic Project of the USSR", v. 2, book 7, p. 565

But at the very last moment, Malyshev and Vannikov wrote the following to Malenkov:

*"In view of the fact that the manufacture of hydrogen bombs will require a significant amount of uranium-235 for the central charge of the bombs themselves and for the production of tritium, charges for the RDS-4 atomic bomb (total weight of the bomb is 1.2 tons) in 1954 can only be made of plutonium, therefore We ask your permission to test the RDS-4 bomb in August of this year with a plutonium charge without the addition of uranium-235.*
*The expected power of the RDS-4 with a purely plutonium charge will be equivalent to 20,000 tons of TNT instead of 25,000 tons with a mixed charge of plutonium and uranium-*

*235."*
**Memorandum by V.A. Malyshev and B.L. Vannikov to G.M. Malenkov on the manufacture and testing of hydrogen and atomic bombs, August 18, 1953.**
"The USSR Atomic Project", v.3, book 2, p. 66.

Result:

*" The RDS-4 atomic bomb was equipped with a plutonium charge weighing (...) from the RDS-2 atomic bomb (a composite charge from the RDS-3 atomic bomb, consisting of (...) plutonium and (...) uranium-235, can also be used."*
**Report by V.A. Malyshev and B.L. Vannikov to G.M. Malenkov on results of the RDS-4 atomic bomb test, September 11, 1953.**
"USSR Atomic Project", v.2, book 7, p. 579

*Edited at 2013-03-24 11:44 (UTC)*

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-23 09:47 (UTC)

**>...by 1955, uranium and plutonium should have become somewhat cheaper. There are no later data on their cost in the "Atomic Project"?**

Approximate figures (for uranium):

*"As for the production of uranium-235, it is necessary to immediately begin work on a significant increase in the capacity of diffusion plants.*
*[...]*
*The cost of 1 kg of uranium-235 will decrease from 1.6 million rubles to 0.6 million rubles.*
*"*
**Draft report of the MSM to G.M. Malenkov on the status of work and tasks in the field of using atomic energy, July 9, 1953.**
"Atomic Project of the USSR", v. 2, book 7, p. 554

Apparently, this refers to the cost of 75% concentration U-235. And if we assume that 90% uranium will also become cheaper, then after the planned expansion of plants 813 and 816 it will cost 790 thousand rubles/kg.

Lithium-6:

*"2. To establish: [...]*
*b) the cost price of 1 kg of metallic lithium-6 produced by plant No. 418 of the Ministry of Medium Machine Building for 1955 in the amount of 342 thousand rubles."*
**From the order of the USSR Council of Ministers No. 5068-rs on increasing the production of lithium-6, establishing selling prices and cost price for it, June 29, 1955.**
"USSR Atomic Project", v. 3, book 2, p. 369

Oh, I almost forgot.
**Very expensive ammunition.**

*"By the summer of 1953, the development of the RDS-7 atomic bomb with a charge of (...) kg of uranium-235, including (...) kg of (...)% concentration and (...) kg of (...)% concentration, was also completed. The total weight of the bomb is 4.6 tons and the expected TNT equivalent is 310 thousand tons.*
*In connection with the high cost of the RDS-7 bomb (140 million rubles) and the possibility of increasing its power by using an external neutron initiator and switching to (...) the design of an atomic charge (...) the RDS-7 bomb was not included in the 1953 test program."*
**Draft report of the MSM to G.M. Malenkov on the status of work and tasks in the field of use of atomic energy, July 9, 1953.**
"Atomic Project of the USSR", v. 2, book 7, p. 550

*"Khariton Yu.B.*
*We always claimed that RDS-7 is cheaper than RDS-6s, with the same design dimensions and the same explosion power (we were "beaten" for this)."*
**Minutes of the KB-11 meeting of 16 and 17.7.54**
"Atomic Project of the USSR", v.3, book 2, p. 202

*Edited at 2013-03-23 10:08 (UTC)*

Answer Level up Discussion thread ♥ Like Complain

**pfc_joker**
2013-03-25 12:46 (UTC)

*The RDS-4 bomb tested in 1953 did have a plutonium charge (like the RDS-2).*

*At first it was assumed that the main charge (MC) of the RDS-4 would be similar to the RDS-3 charge. And now we know what the RDS-3 MC was (taking into account the document from atomhistory).*

Wow, very interesting. And did you pay attention to the phrases about the use of a higher concentration of uranium in the RDS-4 charge compared to the charge of the RDS-3 tested in 1951? As if this implies that initially 75% U-235 was used in the RDS-3 charge?

I will try to answer about the hydrogen bombs (i.e. ask a bunch of additional questions :)) a little later, I need to reread and comprehend everything that is already there.

*Edited at 2013-03-25 12:46 (UTC)*

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-26 11:31 (UTC)

**> And did you pay attention to the phrases about the use of a higher concentration of uranium in the RDS-4 charge compared to the charge of the RDS-3 tested in 1951?**

Well, I usually read what I write. And in the table about RDSs , do you think where *"1952: 17 kt, 1953: 25 kt"* came from ?

**> As if this means that initially 75% U-235 was used in the RDS-3 charge?**

I have already expressed doubts about the claims that 90% uranium was used in the RDS-3 bomb. And the TE increased by more than 40 percent (from 17 to 25 kt) seems to confirm these doubts. But there are quite reputable sources that talk about 90% U-235 in the RDS-3.

But there are no documents. Not a single one. So ... I don't know.

**>I'll try to answer about hydrogen bombs (i.e. ask a bunch of additional questions :))**

Of course, ask. Together we'll try to figure it out.

Answer Level up Discussion thread ♥ Like Complain

**pfc_joker**
2013-03-27 05:20 (UTC)

*But there are no documents. Not a single one.*

In my opinion, from the documents you cited about the RDS-4 charge, it follows quite clearly that 90% U-235 could not have been used in the RDS-3 tested on 18.10.51. Judge for yourself: we know (from a document on atomhistory) that 90% U-235 should have been used in the 25-kiloton RDS-4, and Malyshev's letter to Malenkov says that the charge, obviously, of this particular version of the RDS-4 with the expected full TNT equivalent of 25 kt differs from the charge of the RDS-3 tested in 1951 in the concentration of uranium used in it.

So, in my opinion, it can be considered documented that 90% U-235 was not used in the first RDS-3. And which one was used - of course, it is impossible to say for sure until the relevant places in the documents about RDS-3 are declassified (or posted on the Internet through carelessness).

By the way, I just now noticed that the TNT equivalent of the RDS-3 tested on 23.10.54 is 47.6% higher than the TNT equivalent of the test on 18.10.51 - almost a perfect match with the calculated increase in the TNT equivalent of RDS-4 when switching to 90% U-235. It seems that in the case of RDS-3I it

is customary to attribute this increase in power to INI, but could it not be that this is - at least in part - simply the result of using uranium of a higher concentration? Maybe there are documents in the 6th or 7th books that contain at least some hints on this matter?

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-27 11:19 (UTC)

How persistent you are.

**>In my opinion, from the documents you cited about the RDS-4 charge it follows quite clearly that 90% of U-235 in the RDS-3 tested on 18.10.51 could not have been used.**

You are right.

I will tell you more. In the Resolution of the USSR Council of Ministers No. 4964-2148ss/op "On awarding and rewarding for outstanding scientific work in the field of using atomic energy, for creating new types of RDS products, ..." dated December 6, 1951, neither Artsimovich nor Ardenne are mentioned.
Artsimovich was the head of work on creating an electromagnetic installation, Ardenne developed a new ion source for it. If the uranium-235 obtained on the SU-20 had been used in the RDS-3, then most likely these people would have received something.
But - the resolution mentions Thyssen, Barvich, Ziehl, Hertz, Wirtz, Thieme. But Ardenne - no.
And in general the electromagnetic method of isotope separation is not mentioned.

But, you see, from the admission that there was no 90% U-235 in RDS-3, it follows that people like, for example, Petrosyants, are lying (or provide unverified information).
Exposing our liberal or foreign nonsense - only forward. And I don't want to Petrosyants.
But if there are documents - we will have to.

**>Maybe in the 6th or 7th books there are documents that contain at least some hints on this matter?**

I'll look.

Answer Level up Discussion thread ♥ Like Complain

**pfc_joker**
2013-03-29 13:47 (UTC)

It seems that another document has been found that confirms the version about using 75% uranium-235 (I wrote it in the comments to the post about RDS-3, otherwise why are we discussing it here).

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-31 08:22 (UTC)

**>It seems that another document has been found that confirms the version about using 75% of uranium-235...**

Yes, you are right. I will write later.

*Edited at 2013-03-31 08:23 (UTC)*

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-31 08:17 (UTC)

Here I (very freely) estimated how much the TE of the RDS-3 charge would increase when switching from 75% uranium to 90%:

Initial data:

1) Energy release per unit mass (at efficiency = 100%):

Fission of U-235: 17.6 kt/kg
Fission of Pu-239: 17.3 kt/kg
http://www.nuclearweaponarchive.org/Nwfaq/Nfaq12.html

2) Efficiency of the design with a composite charge (Operation Sandstone, test X-Ray, 1948):

*"Efficiency of utilization of the plutonium in this core was around 35%; uranium utilization was in excess of 25%."*
http://www.nuclearweaponarchive.org/Usa/Tests/Sandston.html

Let's assume that 90% uranium was used in this test.

3) *"Uranium-235 has a power three times less than plutonium in the manufacture of serial atomic bombs, although its cost is two and a half times less than plutonium."*
**Draft report of the MSM to G.M. Malenkov on the state of work and tasks in the field of using atomic energy, July 9, 1953.**
"Atomic Project of the USSR", v.2, book 7, p.551

In the X-Ray experiment, the ratio of the energy release of Pu and U-235 per unit mass was (based on the stated efficiency) 35 / 25 = 1.4, and not 3, as stated in the MSM project.
This gives reason to assume that the Soviet source is talking about 75% uranium.

And in terms of cost, it is also clearly 75% uranium:
*Cost price of 1 conventional unit of tellurium-120: average annual for 1953 - 4,270 thousand rubles*
*[...]*
*Cost price of 1 conventional unit of tin-115.*
*75% concentration - 1,644 thousand rubles* (plutonium/uranium - 2.6 - "two and a half times lower")
*90% concentration - 2,117 thousand rubles.* (plutonium/uranium - 2.0)
http://bookre.org/reader?file=452594&pg=512

Now let's see what energy release will be in RDS-3 if we take the efficiency equal to that achieved in X-Ray (RDS-3 OZ mass - from atomhistory):

75% uranium:
Equivalent amount of plutonium: 4.2 kg (plutonium) + 6.8 kg (uranium) / 3 (from the draft ISM report) = 6.5 kg.
TE will be 6.5 * 17.3 kt/kg * 35% (plutonium efficiency in X-Ray) = 39.4 kt - very close to the Soviet official 41 kt in RDS-3 tests.

90% uranium (according to the American method; Pu efficiency is 35%, U-235 efficiency is 25%):
Energy release:
4.2 kg (plutonium) * 0.35 (plutonium utilization efficiency) * 17.3 kt/kg + 6.8 kg (uranium) * 0.25 (uranium utilization efficiency) * 0.9 * 17.6 kt/kg = 25.43 + 26.93 = 52.4 kt.

Or the increase in TE when going from 75% to 90 will be (52.4 - 39.4)/39.4 = 33%.

Now RDS-4. As we know, for it the TE increased by (25-17)/17 = 47%.
This result means, as it seems to me, not only the transition to uranium of a different concentration, but also a change in the design of the bomb itself.

Answer Level up Discussion thread ♥ Like Complain

**pn64**
2013-03-21 12:09 (UTC)

>I'm a little confused, what was in more short supply - lithium deuteride or uranium-235?

The documents everywhere mention a shortage of lithium-6 (1954-1955).

>On the one hand, it seems to be written in plain text that there was not enough lithium deuteride ...
>But on the other hand, the consumption of lithium deuteride is often not mentioned at all and only the consumption of uranium-235 is discussed ...
>How should this be understood?

Just a guess:
There is a document where Khariton (if I'm not mistaken) and others appeal to the MSM management with a proposal to increase Li-6 production capacity to the level of U-235 production (1 kg per 1 kg). That is, the mention of a certain amount of U-235 automatically means the same amount of Li-6. However, it should be borne in mind that after the RDS-37 test, another proposal was made - to increase Li-6 production compared to U-235.

>And also: "The energy release of the system was calculated in the OPM in the bureau of A.N. Tikhonov for two moments in time: (...).
>The energy release is equal to 21.7 kg (375 thousand tons) and 24.4 kg (420 thousand tons), respectively."
>Does this mean that the energy release corresponds to the entry into a chain reaction of the specified masses of U-235?
>That is, the contribution to the energy release of the thermonuclear reaction >and its efficiency is ignored, or did I misunderstand something?

Most likely, this is the full equivalent of the explosion (U-235, U-238 and thermonuclear reaction), expressed in kilograms of U-235.
It seems that there were similar calculations in the report on the RDS-6s tests. Probably, these are the "standard units" for calculating the energy release in KB-11.
But I do not insist - I can be wrong.

Answer Level up Discussion thread Like Complain

*(no subject)* — **noqnajt** — Expand

**(Deleted comment)**

**pn64**
2015-03-17 06:51 (UTC)

> K-20 - a missile for Tu-95?

"On March 11, 1954, the Council of Ministers issued a decree, according to which OKB-156 was instructed to develop a Tu-95K carrier aircraft for the K-20 aviation missile complex on the basis of the Tu-95MA."
-
http://www.airwar.ru/enc/bomber/tu95k.html

Answer Level up Discussion thread Like Complain

( 16 comments - Leave a comment )

1